

**What is claimed is:**

- 1                   1.     A subharmonic carrier-canceling apparatus for filtering  
2 out second order harmonics close to a local oscillator frequency from an  
3 incoming RF signal, said linearizer comprising:  
4                   a first splitter having a first splitter input, a first splitter I output,  
5 and a first splitter Q output, said first splitter input receiving said incoming RF  
6 signal, said first splitter separating said incoming RF signal into a first splitter  
7 in-phase (I) signal carried by said first splitter I output, and a first splitter  
8 quadrature (Q) signal carried by said first splitter Q output, wherein said first  
9 splitter Q signal is delayed 180 degrees behind said first splitter I signal;  
10                  a second splitter having a second splitter input, a second splitter I  
11 output, and a second splitter Q output, said second splitter input receiving a  
12 local oscillator signal, said second splitter separating said local oscillator signal  
13 into a second splitter in-phase (I) signal carried by said second splitter I output,  
14 and a second splitter quadrature (Q) signal carried by said second splitter Q  
15 output, wherein said second splitter Q signal is delayed 90 degrees behind said  
16 second splitter I signal;  
17                  a first subharmonic mixer coupled to said first splitter I output  
18 and said second splitter I output and receiving said first splitter I signal and said  
19 second splitter I signal, said first harmonic mixer generating a first mixer signal;  
20                  a second subharmonic mixer coupled to said first splitter Q  
21 output and said second splitter Q output and receiving said first splitter Q signal  
22 and said second splitter Q signal, said second harmonic mixer generating a  
23 second mixer signal; and  
24                  a combiner coupled to said first and second subharmonic mixers  
25 and receiving said first and second mixer signals, said combiner combining said  
26 mixer signals to generate an output RF signal having reduced second order  
27 harmonics close to said local oscillator frequency.

16 a combiner coupled to said first and second subharmonic mixers  
17 and receiving said first and second mixer signals, said combiner combining said

18 mixer signals to generate an output RF signal having reduced second order  
19 harmonics close to said local oscillator frequency.

1           5.       The subharmonic carrier-canceling apparatus for filtering  
2 out second order harmonics close to a local oscillator frequency from an  
3 incoming RF signal as recited in claim 4, further comprising a second splitter  
4 having a second splitter input, a second splitter I output, and a second splitter Q  
5 output, said second splitter input receiving said incoming RF signal, said second  
6 splitter separating said incoming RF signal into a second splitter in-phase (I)  
7 signal carried by said second splitter I output, and a second splitter quadrature  
8 (Q) signal carried by said second splitter Q output, wherein said second splitter  
9 Q signal is delayed 180 degrees behind said second splitter I signal;

1           6.       The subharmonic carrier-canceling apparatus for filtering  
2 out second order harmonics close to a local oscillator frequency from an  
3 incoming RF signal as recited in claim 4, wherein said first splitter comprises a  
4 microwave hybrid transformer.

1           7.       The subharmonic carrier-canceling apparatus for filtering  
2 out second order harmonics close to a local oscillator frequency from an  
3 incoming RF signal as recited in claim 5, wherein said second splitter comprises  
4 a microwave hybrid transformer.

1           8.       A satellite communications system, comprising:  
2           a ground station;  
3           a satellite in orbit and in communication with said ground  
4 station, said satellite having a subharmonic carrier-canceling apparatus for  
5 filtering out second order harmonics close to a local oscillator frequency from  
6 an incoming RF signal comprising:

7 a first splitter having a first splitter input, a first splitter I output,  
8 and a first splitter Q output, said first splitter input receiving said incoming RF  
9 signal, said first splitter separating said incoming RF signal into a first splitter  
10 in-phase (I) signal carried by said first splitter I output, and a first splitter  
11 quadrature (Q) signal carried by said first splitter Q output, wherein said first  
12 splitter Q signal is delayed 180 degrees behind said first splitter I signal;

13 a second splitter having a second splitter input, a second splitter I  
14 output, and a second splitter Q output, said second splitter input receiving a  
15 local oscillator signal, said second splitter separating said local oscillator signal  
16 into a second splitter in-phase (I) signal carried by said second splitter I output,  
17 and a second splitter quadrature (Q) signal carried by said second splitter Q  
18 output, wherein said second splitter Q signal is delayed 90 degrees behind said  
19 second splitter I signal;

20 a first subharmonic mixer coupled to said first splitter I output  
21 and said second splitter I output and receiving said first splitter I signal and said  
22 second splitter I signal, said first harmonic mixer generating a first mixer signal;

23 a second subharmonic mixer coupled to said first splitter Q  
24 output and said second splitter Q output and receiving said first splitter Q signal  
25 and said second splitter Q signal, said second harmonic mixer generating a  
26 second mixer signal; and

27 a combiner coupled to said first and second subharmonic mixers  
28 and receiving said first and second mixer signals, said combiner combining said  
29 mixer signals to generate an output RF signal having reduced second order  
30 harmonics close to said local oscillator frequency.

1 9. The satellite communications system as recited in claim  
2 8, wherein said first splitter comprises a microwave hybrid transformer.

1                   10.     The satellite communications system as recited in claim  
2     8, wherein said second splitter comprises a microwave hybrid transformer.

1                   11.     A satellite communications system, comprising:  
2                   a ground station;  
3                   a satellite in orbit and in communication with said ground  
4     station, said satellite having a subharmonic carrier-canceling apparatus for  
5     filtering out second order harmonics close to a local oscillator frequency from  
6     an incoming RF signal comprising:  
7                   a first splitter having a first splitter input, a first splitter I output,  
8     and a first splitter Q output, said first splitter input receiving a local oscillator  
9     signal, said first splitter separating said local oscillator signal into a first splitter  
10    in-phase (I) signal carried by said first splitter I output, and a first splitter  
11    quadrature (Q) signal carried by said first splitter Q output, wherein said first  
12    splitter Q signal is delayed 90 degrees behind said first splitter I signal;  
13                  a first subharmonic mixer coupled to said first splitter I output  
14    and receiving said first splitter I signal and said incoming radio signal, said first  
15    harmonic mixer generating a first mixer signal;  
16                  a second subharmonic mixer coupled to said first splitter Q  
17    output and receiving said first splitter Q signal, said second harmonic mixer  
18    generating a second mixer signal; and  
19                  a combiner coupled to said first and second subharmonic mixers  
20    and receiving said first and second mixer signals, said combiner combining said  
21    mixer signals to generate an output RF signal having reduced second order  
22    harmonics close to said local oscillator frequency.

1           12.    The satellite communications system as recited in claim  
2 11, further comprising a second splitter having a second splitter input, a second  
3 splitter I output, and a second splitter Q output, said second splitter input  
4 receiving said incoming RF signal, said second splitter separating said incoming  
5 RF signal into a second splitter in-phase (I) signal carried by said second splitter  
6 I output, and a second splitter quadrature (Q) signal carried by said second  
7 splitter Q output, wherein said second splitter Q signal is delayed 180 degrees  
8 behind said second splitter I signal;

1           13.    The satellite communications system as recited in claim  
2 11, wherein said first splitter comprises a microwave hybrid transformer.

1           14.    The satellite communications system as recited in claim  
2 12, wherein said second splitter comprises a microwave hybrid transformer.

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